United States
Department of
Agriculture

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**Agricultural
Research
Service**

ARS-47

April 1986

Saval Ranch Project — An Interdisciplinary Evaluation of Intensive Cattle Grazing Management

ABSTRACT

Eckert, Richard E., Jr. 1986. Saval Ranch project - An interdisciplinary evaluation of intensive cattle grazing management. U.S. Department of Agriculture, Agricultural Research Service, ARS-47, 22 p.

The Saval Ranch is a commercial cattle enterprise in northeastern Nevada. Public lands on the grazing allotments are managed by the Bureau of Land Management and the U.S. Forest Service. The area is rich in natural resources. As such, this ranch offers many and varied opportunities to develop and test hypotheses about the effects of cattle grazing treatments on the total ecosystem and on economics under environmental and political realities. An integrated approach to resource management under real-life situations has been lacking in the sagebrush-grass ecosystem. Such an approach is necessary for ultimate commercial application of results.

Certain environmental and planning documentation was required before large-scale grazing treatments could be implemented. A resource inventory and environmental assessment were completed. The coordinated ranch and allotment management plan is operational, and grazing treatments began in the spring of 1985. The proposed grazing plan can be altered at any time if evaluations show an adverse effect on any resource component. Research projects to be conducted by the Agricultural Research Service, University of Nevada-Reno, and the Bureau of Land Management are in place, and applied and basic investigations are expected to continue for 12 years. Integration of individual research projects has been accomplished by using a common data management base and a systems model.

Monitoring and research programs will be reviewed periodically to determine the timely conclusions of these studies and the initiation of other studies needed to answer new questions within the total integrated project. Extension of monitoring and research results to other areas in the sagebrush-grass ecosystem will be accomplished by extrapolation on an ecological site basis and by modeling of functional relations developed through basic research.

KEYWORDS: Coordinated management plan, cultural resources, economics, environmental assessment, fisheries, integration and modeling, interdisciplinary research, resource inventory, soil, vegetation, watershed, wildlife.

ACKNOWLEDGMENTS

Information has been provided by the following cooperating agencies and project scientists:

Bureau of Land Management: Vegetation inventory, environmental assessment, coordinated management plan, and monitoring studies.

Nevada Agricultural Experiment Station: Cultural inventory.

Project scientists: Agricultural Research Service; University of Nevada-Reno; U.S. Forest Service, Intermountain Forest and Range Experiment Station; and Bureau of Land Management: Interdisciplinary monitoring and research studies.

Saval Ranch: Environmental assessment and coordinated management plan.

Saval Ranch Steering Committee: Objectives, environmental assessment, coordinated management plan, and monitoring and research studies.

Soil Conservation Service: Soil inventory, environmental assessment, coordinated management plan, and monitoring studies.

U.S. Forest Service: Environmental assessment, coordinated management plan, and monitoring studies.

The Saval Ranching Company is a privately owned enterprise in northeastern Nevada. The ranch, cattle, and grazing allotments were made available for the interdisciplinary study described. Funding for this project is provided by the Bureau of Land Management, Agricultural Research Service, U.S. Forest Service, and University of Nevada-Reno.

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SAVAL RANCH PROJECT - AN INTERDISCIPLINARY EVALUATION OF INTENSIVE CATTLE GRAZING MANAGEMENT

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The history of introducing livestock into the West and the resulting ecological changes have been documented by Young et al. (1976). Hyder and Bement (1977) stated that "it is no longer necessary to validate the statement that overgrazing has deteriorated, or even destroyed, some rangeland ecosystems." Hormay (1956, 1970) and Hyder and Bement (1977) attributed the deterioration of vegetation to grazing habits of livestock. For example, under season-long grazing, cattle tend to graze the better forage species on preferred sites during the growing season. These same species and sites are heavily grazed year after year even though other parts of the range are lightly or moderately used. This problem is accentuated by rough topography, limited sources of water, plant communities with species of great variation in palatability, and unfavorable climatic conditions.

Land management agencies have sought to solve this problem by reducing livestock numbers. In many instances, even the reduced number of animals continued to overgraze the preferred species and sites while forage on steeper slopes and farther from water remained underutilized. Fewer animals also meant a reduced ranch income.

What then is a possible solution to this problem of unequal distribution of grazing pressure among sites and species under extensive rangeland management? When plants periodically are able to complete their life cycle without grazing, vigor and production increase. Hickey (1967) and Herbel (1971) cited many examples of grazing management systems that included an ungrazed treatment for this purpose. Under intensive grazing management on extensive rangeland areas, this ungrazed treatment has been either a deferment - a delay in grazing use during the year to allow seed production and increased carbohydrate storage, or a rest - a delay in use for at least a year to provide the benefits of deferment as well as to allow for seedling establishment and wildlife habitat improvement. When ungrazed treatments are systematically scheduled among pastures and years, the terms deferred rotation and rest rotation are used to describe a particular management system.

During the 1960's and 1970's, the Bureau of Land Management (BLM) and U.S. Forest Service (USFS) have implemented grazing systems that include an ungrazed treatment in an attempt to allow vegetation improvement as well as to enhance multiple-use values. For example, as of 1978, the BLM had implemented some 1,164 grazing plans on about 27 million acres (BLM, 1978). Presently this agency is under court order (U.S. District Court, District of Columbia, 1974) to write 144 Environmental Impact Statements (EIS) on about 174 million acres of rangeland. Most management actions resulting from EIS's completed to date propose grazing systems that include a deferred or rested treatment.

However, these intensive grazing systems will be applied to millions of acres of public rangelands with little knowledge of their effects on livestock production or on renewable natural resources. A search of the literature revealed that evaluations of management systems have been based mainly on studies of vegetation responses with some livestock performance data. Within the intermountain region, only one comparison of grazing systems has been made using these two criteria (Hyder and Sawyer, 1951). Little quantitative information is available on the effects of grazing systems on wildlife or hydrology. An integrated study of the responses of all renewable resources to a grazing management plan has never been attempted

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nor has an economic evaluation of all the cost and benefits of such a plan.

The Saval Ranch and grazing allotments are well suited for the long-term, interdisciplinary monitoring and research needed to provide a quantitative evaluation of livestock grazing management treatments in the sagebrush-grass ecosystem. Development of a management plan and research program was undertaken in 1978 as a cooperative effort among the BLM, USFS, Agricultural Research Service (ARS), University of Nevada-Reno, Soil Conservation Service (SCS), and the Saval Ranch. The overall objective is to evaluate the effects of livestock grazing management and range improvements on vegetation, livestock production, fish and wildlife and their habitats, watershed values, water quality, and other resources (USDA, 1981).

This objective will be achieved by--

(1) Inventory of the basic resources in sufficient detail to guide the development of sound grazing management and improvement practices

(2) Design and implementation of grazing management plans and range improvements based on inventory information, livestock requirements, and multiple-use needs

(3) Establishment of a monitoring and research system of sufficient precision to detect changes in resources, and a procedure to determine the costs of implementing a complete management system and the economic benefits derived

Monitoring and research of intensive grazing plans will further an understanding of the complex relationships among the physical, biological, and economic factors involved in the management of rangelands on 143 million acres in the sagebrush-grass ecosystem.

It should be stressed that steps from inventory, through an environmental assessment, to development of the grazing plan typify the process required of land management agencies in developing intensive grazing management plans when this study was undertaken in 1978. The only difference is that a large-scale planning effort would require an environmental impact statement rather than an environmental assessment.

HISTORY OF THE SAVAL RANCH AND GENERAL DESCRIPTION OF THE STUDY AREA

W.F. Mahoney purchased several small ranches on Gaunce (now Gance) Creek in northeastern Nevada in the late 1800's or early 1900's and developed a sheep business. In the early 1900's, Guy Saval bought the ranch and made it his sheep headquarters for Elko County. Chauncy W. Griswold bought the property in 1915, formed the Saval Livestock Company, and had sheep and cattle. In 1935, the ranch was owned by Charles H. Sewell, who held a permit for 500 sheep but changed to a cattle operation in 1937. Newton Crumley, Jr., purchased the ranch in 1945 and retained it as a cattle (cow-calf and steer) operation. P.F. Westerberg and T.R. Tanner bought the ranch in 1949 and owned it for 4 years. The ranch was sold to Michael Darling in 1953. In 1973, Darling sold the ranch to a partnership of Dr. and Mrs. Greer Edwards, Mr. and Mrs. Robert Ojemann, and Lynn Rose. Rose later sold his interest to the remaining partners. In 1977, the owners purchased the adjacent Haystack Ranch. The Saval Ranch has two BLM grazing allotments, Mahala Creek and Sheep Creek, and one National Forest (NF) allotment, the East Independence.

The Saval Ranch and grazing allotments are located about 40 miles north of Elko, NV (fig. 1) and comprise about 49,100 acres. Some 7,556 acres of private land include 1,708 acres of meadows, 1,550 acres of crested wheatgrass, and 4,298 acres of native rangeland. About 25,904 acres are BLM lands and 15,640 acres are NF lands.[2]

According to the Advance Soil Survey (USDA, 1979), elevation varies from about 5,800 to about 9,100 feet. Topography consists of three major landscapes--mountains and low hills, alluvial fans and terraces, and flood plains and drainages. Climate of the area is semiarid with cold, moist winters and warm, dry summers. Air temperature varies from an average of about 49°F at the low elevations to less

[2]Data are on file with Bureau of Land Management, P.O. Box 831, Elko, NV 89801.

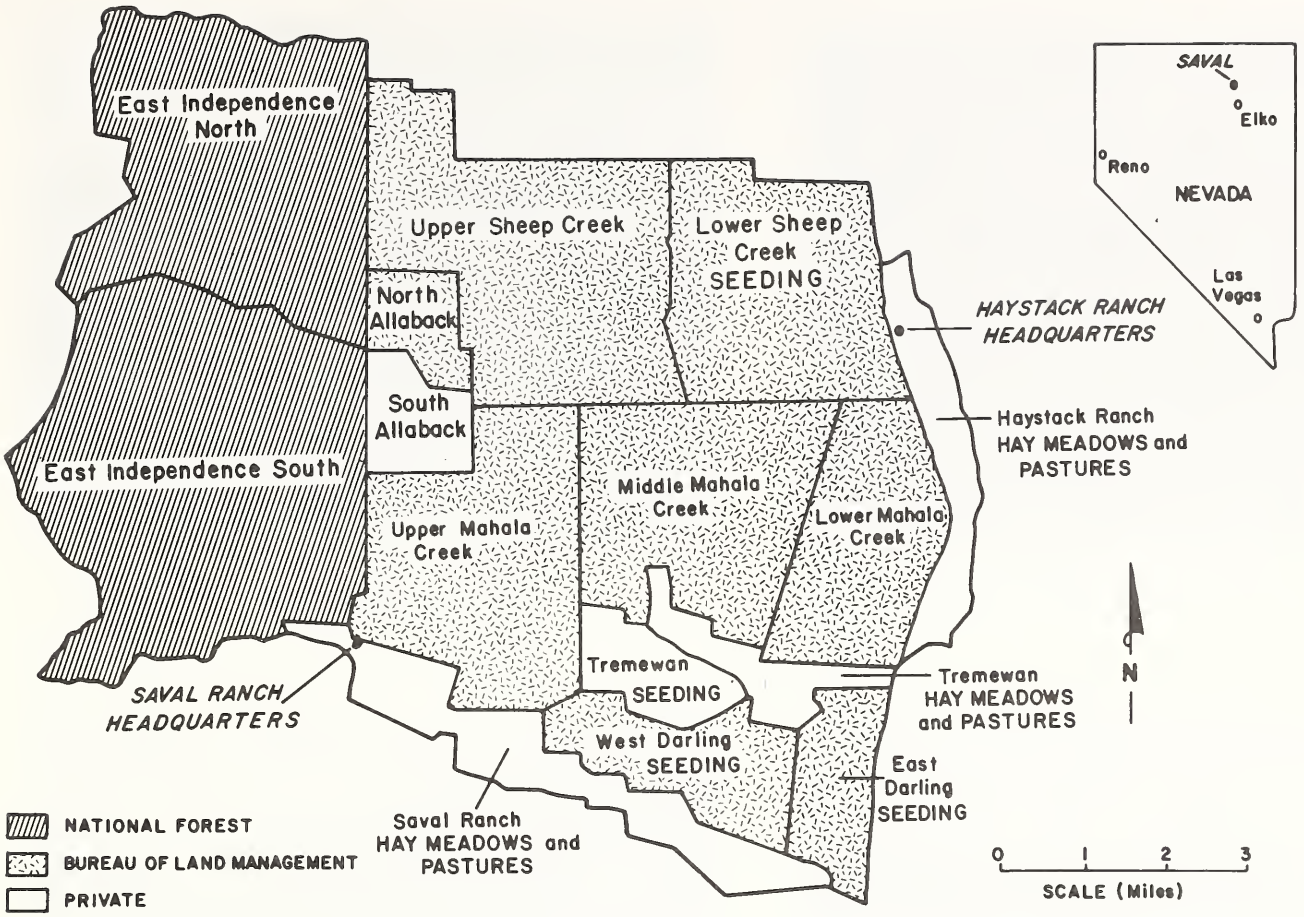

Figure 1.--Native and seeded rangelands, hay meadows, and pastures on the Saval Ranch allotments.

than 42° in the mountains. Precipitation was estimated to average about 9 inches in the lower valleys and 18 inches in the mountains.

The principal soils are Aridisols and Mollisols. Flood plain soils are very deep, dark, poorly drained, and calcareous. Soils on the alluvial fans are dark, very slowly permeable to water, and with silica hardpans. Upland soils are dark, moderately to slowly permeable to water, and on steep slopes.

Natural vegetation is typical of the northern intermountain region. Common shrubs are sagebrush, rabbitbrush, bitterbrush, snowberry, serviceberry, and chokecherry.[3] Important grass and grasslike species are needlegrass, bluegrass, squirreltail, wheatgrass, fescue, bromegrass, wildrye, sedge, and rush. The most abundant broadleaf species are balsamroot, phlox, aster, milkvetch, hawksbeard, groundsel, wyethia, and buckwheat. Streamside vegetation is characterized by aspen, willow, and meadow types. In addition, there are about 4,730 acres of crested wheatgrass, an introduced species. The Saval Ranch and grazing allotments contain four sources of forage--privately owned native hay meadows (grass hay and grazing aftermath) (fig. 2), BLM and private crested wheatgrass seedings (fig. 3), BLM native range (fig. 4), and NF native range (fig. 5). Both BLM and NF native range areas contain parcels of intermingled private land, mainly along watercourses.

[3]For scientific names of plants and animals, see the appendix, p. 19.

Figure 2.--Private hay meadow.

Figure 3.--Crested wheatgrass seeding on Bureau of Land Management land.

Figure 4.--Sagebrush-grass type on Bureau of Land Management native range.

Figure 5.--Sagebrush-grass, mountain brush, and aspen types on National Forest native range.

INVENTORY RESULTS

An inventory of basic resources[4] was conducted from 1978 to 1980 by cooperating agencies and project scientists to--

(1) Provide data for preparing the Saval environmental assessment and Saval coordinated management plan

(2) Determine the herbage available for various uses

(3) Establish baseline data from which to monitor change in resources

(4) Select important ecosystem components for research

The inventory results and interpretation of these data for each resource are briefly summarized as follows:

Soil

An Order 3 soil survey was conducted on private and public lands. The soil series was the taxonomic unit used for field mapping and for naming soil-map units. Interpretations from soil profile characteristics were used to plan revegetation projects, reservoir construction, and improvement practices for private hay meadows.

Vegetation

Vegetation characteristics were determined by the Soil-Vegetation Inventory Method (SVIM) (USDI, 1979) on both private and public lands. This method is not currently used by BLM. Soil information and existing plant communities were used to delineate 26 interpretive units of potential vegetation called ecological sites.[5] Vegetation production data collected on these ecological sites were used to determine the amount of herbage available for cattle and wildlife forage and for nonconsumptive uses. Half of the annual production was estimated to be available for use by cattle and deer and the remaining herbage for other wildlife species and for plant maintenance and reproduction. Analysis of production data showed that BLM pastures contained from 36 more to 51 percent fewer Animal Unit Months (AUM's) of forage than presently used.

Pastures on the NF contained 17 percent more AUM's of forage than presently used. Two candidate plant species for "threatened" and "endangered" status were found--Owyhee sagebrush and arching pussytoes.

Wildlife - Game and Furbearers

The mule deer is the most abundant big game species. The pronghorn antelope is occasionally sighted on BLM land during early spring but is not known to be a year-round resident. The mountain lion is both resident and transitory, with movement dependent on annual migrations of the mule deer, its main prey. Bobcat, beaver, badger, and long-tailed weasel are the most common furbearers.

The sage grouse is the most abundant and widely distributed upland game bird. There are 10 sage grouse strutting grounds, all on BLM land. Chukar, Hungarian partridge, and blue grouse are present in limited numbers in riparian habitats. Cottontail rabbit, pigmy rabbit, and white-tailed jackrabbit are found in specific habitats. The mourning dove is found in early spring and summer, with highest densities in disturbed riparian habitats. Pintail, mallard, cinnamon teal, and Canada goose occur throughout the area on wetlands and riparian habitats.

Wildlife - Nongame

Nongame animals are represented by 160 species--35 mammals, 115 birds, 7 reptiles, and 3 amphibians. The deer mouse is the most abundant nocturnal rodent, followed by the Great Basin pocket

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[4]Inventory results are on file with USDA, ARS, 920 Valley Road, Reno, NV 89512.

[5]An ecological site is a kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management (Range Inventory and Standardization Committee, 1983).

mouse. The least chipmunk is the most abundant and widespread diurnal rodent. Four species are rather limited in their distribution--sagebrush vole, Richardson's ground squirrel, Townsend's ground squirrel, and bushy-tailed wood rat. The highest density of rodents is found in riparian habitats. Densities of the black-tailed jackrabbit and coyote, the principal predator of jackrabbits, appeared to increase during the inventory period.

Brewer's sparrow, western meadowlark, sage thrasher, and vesper sparrow are important bird species in lower elevation sagebrush habitats. The green-tailed towhee and warbling vireo are most abundant in more mesic mountain habitats. The highest number of bird species (22) is found in the aspen woodland sites along stream channels. The yellow warbler is the most abundant species on these sites and on the low and high elevation grass-willow types. Brewer's blackbird, red-winged blackbird, and robin are also common in the low elevation grass-willow type. On meadow sites invaded by sagebrush, shrub-nesting species characteristic of sagebrush habitat, such as the green-tailed towhee and Brewer's sparrow, are abundant. The Savannah sparrow and western meadowlark are the most abundant species on hay meadows.

Raptors residing and breeding in the area include the golden eagle, red-tailed hawk, Swainson's hawk, goshawk, Cooper's hawk, great horned owl, long-eared owl, marsh hawk, and American kestrel. The large rodent and passerine bird populations provide the main prey for these raptors.

Wildlife Habitat

During the SVIM inventory, "Special Habitat Features" (SHF) were identified. They are defined as specific components of the environment that require specific attention as wildlife-use areas. They can be either natural or man made and can be either beneficial or detrimental to wildlife. Springs and seeps, rock outcrops, wet and dry meadows, and stock ponds are the most abundant SHF's. These habitats were described by vegetation and ground-cover characteristics. In addition, animals using these habitats, type of use (breeding, rearing of young, migration), and season of use were also indicated. Generally those habitats associated with open water, season-long green vegetation, or cover receive heavy wildlife use. Collectively, SHF's provide habitat for the total life cycle of many species, part of the migration habitat, and breeding, bearing, and rearing of young. Yearlong and spring-summer appear to be the most important periods of occupancy.

Watershed

Annual precipitation during the inventory period varied from 7.4 inches at the lower elevations to 32.9 inches at the highest elevations. A maximum temperature of 96°F was recorded in July and the minimum of -22° in January. Seven creeks originate on NF land and flow through most of the study area. Four are perennial and three are ephemeral. A stream-channel classification showed that these creeks have the following characteristics: (1) Drainage density (miles of stream per square mile of watershed) is low; (2) flow is confined to main channel and a few major ephemeral tributaries; (3) maximum discharge from each stream is expected to vary between 100 and 200 cubic feet per second; (4) large volumes of unconsolidated sediments are stored in the channel system, particularly in lowland areas; and (5) bank cutting is evident in 20-30 percent of the channel system. In general, channels near the headwaters of these creeks are stable to slightly unstable. Head cutting, however, is active in certain lowland areas with channel depths from 1-5 feet in most areas to 6-12 feet in some reaches.

Stream flow and water quality sampling showed that the highest flow from spring runoff was 42 cubic feet per second. Maximum flow from a rain-on-snow event was not measured but was estimated at 25-40 cubic feet per second. Total runoff from individual streams in 1979 and 1980 varied from 49 to 188 acre feet from early May to early July. In general, streams in mountainous areas of each watershed had

the greatest sediment concentration. From early April to early July in 1980, average sediment concentrations varied from 16 to 1,146 parts per million.

In general, chemical data indicated waters of suitable quality for all existing uses. Coliform levels may be high enough to make human consumption unwise. Some water samples had manganese, arsenic, and sulfate levels that exceeded established drinking water standards. However, these samples were taken from small tributaries below a mine or a seep area, and quantities of these chemicals were insufficient to affect water quality on the main streams due to dilution.

Stream Habitat and Fisheries

The Lahontan cutthroat trout, a federally listed "threatened" species, is the only game fish present. Platts and Nelson (1983), however, speculated that this population may actually be the Humboldt cutthroat trout. There are 68 miles of stream. Three of seven streams are ephemeral and have no fishery value. They flow only during snowmelt, and channels are dry during most of the year. Four streams totaling 52 miles have only 4 miles with fishable populations. Most fishable areas are on NF land, where habitat conditions vary from poor to fair. Fish habitat is poor and fish density is very low on BLM land.

Factors affecting fish habitat are pool quality, pool:riffle ratio, and bank stability. Pools are of low quality and riffles and pools are often filled with sediment. Creeks in poor environmental condition lack the vegetative cover on streambanks necessary to protect them from even light livestock trampling. Some creeks have enough bank cover to protect against moderate livestock use.

An inventory in 1978, compared with those made in 1955 and 1973, indicated that fishery habitat may have declined (USDA, Forest Service, and Nevada Department of Fish and Game, 1978). Fish populations were 457 cutthroat trout per mile in 1973 and 145 per mile in 1978 on 1 creek. The potential for this creek was estimated to be 750-1,000 trout per mile. Trout populations in 2 less productive streams were estimated to be 18 and 106 fish per mile.

Macroinvertebrate analyses showed that the diversity index of insect species varied from poor to fair in the least productive stream and from good to excellent in the most productive stream (Mangum, 1978). Water samples collected near the headwaters of all streams contained several clean-water taxa. Samples taken downstream, or later in the season, or where cattle had been grazing contained taxa more tolerant to excessive organic enrichment.

Cultural Resources

A survey of BLM and private lands described the types of cultural resources present. It revealed 134 prehistoric sites. Artifacts indicate use beginning about 5,000 years ago and continuing into historic times. Sites contain isolated flakes, isolated projectile points, small to medium camps, and extensive elongated lithic scatters with grinding stones. Seven historic sites appear to be associated with sheep and cattle ranching beginning in the late 1800's.

Most prehistoric sites occur in the western half of the study area. The most likely explanation for this distribution is availability of water during occupancy. Creeks are more perennial in nature, and water is of better quality closer to the mountains. Moreover, many aboriginal food plants are associated with water, and water also attracts game animals and contains fish. The geomorphic setting of these sites along streams suggests that they may have been selected because of distance and direction of water, wind direction, and elevation above water or surrounding terrain.

Analysis of Inventory Results

Analysis of inventory results on private and public land (USDI, 1981) revealed the following problems associated with the present management of land and livestock:

(1) Poor livestock distribution
(2) Overutilization (greater than 50 percent) of desirable vegetation on meadow and bottom sites
(3) Low ecological range condition: 7 percent early seral, 71 percent midseral, and 22 percent late seral
(4) Lack of early spring forage
(5) Poor vegetation condition on irrigated pastures and meadows
(6) Low conception rates
(7) Extended calving season (90 days at present)
(8) Livestock-wildlife competition for habitat, particularly in riparian areas on mule deer range
(9) Potential disease and predator problems and increased feed costs when cattle are confined to winter feeding grounds on meadows

ENVIRONMENTAL ASSESSMENT

Resources on the Saval Ranch and grazing allotments were described in the inventory. The Environmental Assessment (EA) (USDA and USDI, 1981) analyzed the positive and negative effects of grazing management treatments on these resources. The EA was for grazing only, but it will be supplemented with assessments for each planned range improvement project.

Alternative management plans were developed in the EA by an interdisciplinary team. In this process, criteria were determined to evaluate each alternative management action and to select the preferred alternative. These criteria were based on laws, executive orders, and regulations; goals and objectives of BLM, NF, and Saval Ranch; and tests of technical, economic, and political feasibility. The criteria were as follows: Impacts on—
(1) Soil productivity
(2) Riparian areas
(3) Implementation cost
(4) Vegetation condition
(5) Annual calf crop
(6) Pounds of beef produced
(7) Ranch work load
(8) Key mule deer summer habitat
(9) Sage grouse strutting, brooding, and wintering habitat
(10) Owyhee sagebrush and arching pussytoes habitats
(11) Lahontan cutthroat trout habitat
(12) Identified cultural resources

During the evaluation process, some criteria were eliminated because impacts associated with them were judged insignificant. These final 12 evaluation criteria were identified as key, unique, and general. Items 1-3 were the most significant issues and concerns. Items 10-12 represented constraints unique to the management plan, or subject to legal standards, or both. Items 4-9 were used to evaluate relative differences in beneficial and adverse effects of implementation of each management alternative.

Of the nine alternatives developed, only two were considered feasible. Although a no-action alternative was not feasible, it was included to illustrate the effects of the feasible alternatives. The alternatives excluded from final consideration were deemed impractical because (1) the excessive amounts of vegetation manipulation needed did not meet one or more evaluation criteria; (2) these alternatives did not meet range improvement needs as well as the feasible alternatives; and (3) implementation of any of these alternatives probably would not allow the ranch to be a profitable enterprise.

Alternative 1 was no action. Alternative 2 was a plan to provide forage to accommodate 850 cow-calf pairs and 300 to 400 yearlings. Cultural and structural improvements for public and private land recommended for implementation of this alternative were as follows:

Public land:

2,400 acres seeding of a grass-forb mixture
12 miles of fence
14 miles of fence repair
28 reservoirs
2 wells with windmills
11 miles of pipeline
12 spring developments
9 pit tanks
27 troughs
7 troughs repaired
11 cattle guards

Private land:

1,200 acres fertilized per year for 5 years
100 acres with improved irrigation per year for 5 years
18 acres of willow control
399 acres of seeding

In addition to the seeding on BLM land, alternative 3 would require two 200-acre brush control (spraying) projects on NF land. Subdividing the two existing NF pastures into four pastures would require an additional 7 miles of fence construction. Other structural developments as well as the stocking rate would be the same as in alternative 2. These alternatives were subjected to the evaluation process described here.

The consequences of implementing each alternative were summarized in the Environmental Assessment (USDA and USDI, 1981) as follows: Alternative 1 would maintain the current ranch and rangeland situation; however, some adjustment of stocking levels in each pasture would be required. No change would be expected in the ranch work load. The public rangelands would probably remain in the present range condition. Most of the riparian habitats would remain in poor condition with little possibility for improvement. Wildlife populations, which depend on the riparian areas, as the Lahontan cutthroat, would possibly remain stable or decrease in numbers because of poor habitat condition. No change would be expected in the mule deer and sage grouse populations. Soil productivity would probably not change except in riparian zones, where lack of streambank cover would result in soil displacement and erosion. Only normal administrative cost for maintaining the present management would be required. None of the goals or objectives of the proposed research and demonstration project would be attained. The greatest loss would be the information gained by implementing and evaluating the coordinated management plan.

Alternatives 2 and 3 should enhance the current rangeland and ranch situations. The proposed brush control and seeding projects should increase carrying capacity. Improvements of private meadows should increase hay production. Cattle could be maintained on wintering grounds and seedings longer. A resulting later turn-in date and decreased grazing pressure on native ranges would allow for an increase in plant vigor, reestablishment of perennial grasses, increased vegetation and litter cover, improved wildlife habitat, and decreased erosion.

Alternatives 2 and 3 would be identical in terms of potential effect on sage grouse habitat. Both may adversely affect at least 7 of the 10 strutting grounds on the project area because of the proposed seeding. The threatened Lahontan cutthroat trout would be expected to respond favorably to improved range management practices if vegetation on riparian areas improves. None of the cultural resources or candidate threatened plants would be adversely affected.

Alternative 2 was chosen as the preferred action over alternative 3 because (1) it requires less fence construction and maintenance on NF land; (2) it has more favorable-sized pastures; and (3) it minimizes the number of livestock moves on NF land.

DEVELOPMENT OF THE COORDINATED MANAGEMENT PLAN

After selection of the preferred action in the environmental assessment, the coordinated management plan for the Saval Ranch was developed (USDA, 1981). This plan was based on objectives and constraints of the BLM's Humboldt Management Framework Plan, of the Humboldt National Forest's Multiple Use Management Plan, and of the Saval Ranch. In order to ameliorate or solve the land and livestock problems defined previously, the plan was designed to meet the following objectives:

(1) Improve livestock distribution through fencing, water development away from creeks, use of range riders, and proper salting techniques

(2) Improve range condition from early to late seral and increase production to 60 percent of potential within 15 years on

3,300 acres

(3) Improve range condition from midseral to late seral and increase production to 70 percent of potential within 15 years on 34,980 acres

(4) Maintain vegetation presently in late seral range condition on 10,820 acres

(5) Increase hay land production from the current 1,600-1,800 to 3,000-3,400 tons within 6 years through meadow improvement practices

(6) Eliminate active head cutting in trout streams within 3 years

(7) Minimize forced moves of cattle to maximize weight gain

(8) Increase calf crop from 70 to 80 percent (based on the number of calves weaned as a percentage of total cows exposed) within 10 years

(9) Increase calf weaning weights from 350 to 450 pounds and increase yearling weights from 650 to 750 pounds within 10 years

The coordinated management plan selected to meet these objectives consists of three grazing plans, one for each of the rangeland forage sources: (1) A three-pasture deferred-rotation plan on seeded range, (2) a three-pasture rest-rotation plan on BLM and private native range, and (3) a two-pasture deferred-rotation plan on NF and private native range. These plans (table 1) and rationale for each grazing treatment are based on plant growth characteristics and the need to provide periodic deferment or rest from grazing (USDI, 1981).

Table 1.--Sequence and date of grazing treatments within rotation cycle for 3 management plans

Management plan and pasture No.	Year and treatment (A-H)		
	1	2	3
BLM seeded range - 3-pasture deferred rotation:			
1.....	A (4/15-5/8)	B	C
2.....	B (5/9-5/30)	C	A
3.....	C (10/1-10/30)	A	B
BLM and private native range - 3-pasture rest rotation:			
1.....	D (6/1-6/15)	E	F
2.....	E (6/16-6/30)	F	D
3.....	F (rest)	D	E
NF and private native range - 2-pasture deferred rotation:			
1.....	G (7/1-8/15)	H	...
2.....	H (8/16-9/30)	G	...

BLM seeded range - three-pasture deferred rotation. These pastures are in the lower part of the BLM allotments. Treatment A is early spring grazing designed to allow removal of cattle from winter feeding areas as soon as possible. Forage will be limited if cold weather persists in the spring and livestock production will be less than optimal. However, some cured forage may be available if it was not completely used during treatment C in the fall. Root growth is restricted during grazing, and carbohydrate reserves are depleted. However, many of the negative effects of early spring grazing would be reduced or eliminated if regrowth occurs after grazing pressure is removed. Regrowth is expected in most years.

Treatment B is deferment during the early part of the growing season. More and higher quality forage is available for livestock production than in treatment A. Some root growth occurs before grazing, but a large proportion of carbohydrate reserves is depleted in production of herbage and subsequent grazing. Regrowth would be minimal in most years because soil moisture is limiting by the end of the grazing period. Grazing at this time is considered to be potentially most damaging to grass plants. Therefore the pasture grazed at this time in 1 year is rested until fall of the following year (treatment C).

Treatment C is rest during the growing season and graze in the fall. Seed is produced, carbohydrate reserves and plant vigor are increased, litter accumulates, and the opportunity for seedling establishment is enhanced. Grazing occurs when plants are dormant and dry herbage is softened by fall precipitation. Forage quality is low at this time of year unless fall regrowth has occurred.

BLM and private native range - three-pasture rest rotation. These pastures are in the middle and upper parts of the BLM native range area. Treatment D is grazed during active growth and flowering of many native grasses. Quantity and quality of forage are optimal for livestock production. Grazing at this time, however, slows root growth, and plant cover for watershed protection is removed. If regrowth occurs, carbohydrate reserves are at least partially replenished, plant vigor is increased, and perhaps some seed is produced during the summer and fall rest. Summer and fall rest also removes grazing pressure on browse species and provides vegetation and litter cover for wildlife habitat and soil protection in the fall and winter and in the early spring of the following year.

Treatment E is late spring use of native grasses. Plants will have made good top and root growth prior to grazing and will be productive. Quality of early maturing species will be declining. Quality of late maturing species and vegetation growing on mesic sites will still be optimal for livestock production. Grazing at this time will deplete root reserves in plants that are in the reproductive stage. Regrowth after grazing could minimize these negative effects; however, little or no regrowth would be expected because of limited soil moisture in late June of most years. Grazing at this time is considered to be potentially damaging to grass plants. Therefore the pasture grazed at this time in 1 year is rested the following year (treatment F).

Treatment F is no grazing for 1 year. This rest allows plants to complete their life cycle without a grazing disturbance and favors establishment of any seedlings present. Litter accumulates, root reserves are maximized, plant vigor increases, and seed is produced. Cover for wildlife habitat and for soil protection is present for the entire year.

NF and private native range - two-pasture deferred rotation. These pastures are at higher elevations. Treatment G is grazing use during flowering and seed development. Grazing will greatly reduce seed production by desirable species. Forage production is high, but forage quality is declining. Late summer and fall rest after grazing may favor carbohydrate storage and plant vigor as well as residual cover for wildlife habitat and for soil protection if proper utilization is attained or if regrowth

occurs. Unused browse would be available for wildlife use late in the fall.

Treatment H is grazing use after most species are mature and seed is ripe. Nutritive value of most plants is low. Plant vigor and root carbohydrate levels would be maximized because plants were able to complete their life cycle before grazing. Browse and forbs would be available for wildlife use during the entire summer, a critical time in the development of young animals.

The grazing plans for BLM seeded range and BLM and private native range complete a cycle every 3 years. The grazing plan for NF and private native range completes a cycle every 2 years. The dates shown in table 1 are not a rigid timetable for cattle movement among pastures. Rather, flexibility is necessary for the success of any management plan. Flexibility in a grazing schedule can reduce the problems of weather-affected forage production, can reduce conflict with peak ranch work load, allow time for natural cattle drift between pastures, and allow time for slow, forced movement of cattle to prevent separation of cow-calf pairs and to minimize weight loss.

The flexibility allowed on BLM land is an 8-day leeway before or after the stated turn-in or removal date for all pastures except the early grazed seeded pasture. Seeded pastures are not grazed before April 15. Flexibility for NF land is a 15-day leeway for moves between pastures and for removal of cattle at the end of the grazing season.

Certain cultural and structural range improvements for public and private lands were recommended to facilitate the operation of this management plan (table 1). Costs of improvements will be borne by Federal agencies on public land and by the Saval Ranch on private land. The seeded pasture will provide the additional AUM's of forage needed to maintain livestock numbers at a profitable level, while specific pastures are deferred or rested to improve vegetation and those multiple-use values dependent on the vegetation resource. The site selected for the seeding is in such low range condition that no positive response to grazing management could have been obtained in the foreseeable future. Fences are needed to improve cattle distribution in the grazed pastures and to restrict cattle from the deferred or rested pastures. Water developments provide the additional water needed when cattle are concentrated in a pasture as well as to draw cattle away from riparian and other favored sites in mountainous terrain. Increased hay production on private land reduces the need to purchase winter feed and allows the ranch to feed cattle into the spring until seeded range is ready for grazing.

MONITORING AND RESEARCH APPROACHES

Monitoring and research approaches described here were developed by scientists and land managers. These studies represent the best estimate of information needed to quantitatively evaluate the effects of grazing management and land treatments on each resource but are not all inclusive. Some of the initial subject matter and approach was dictated by an immediate need to establish baseline data and a need for wildlife habitat data before vegetation was destroyed by range improvement treatments, with emphasis on economic wildlife species. During this project, other research topics will surface as a result of the modeling effort and a need to answer questions about why certain resource responses occur.

The following summaries include the objectives and proposed monitoring and research approaches for each resource evaluation.

Climatology

(1) Document the climatic characteristics of the study area
(2) Provide a reference for extrapolation of resource data to other sites
(3) Provide data to other researchers to account for climatic variability in measurements of resource responses to cattle grazing

Eleven climate stations were installed in 1978 to measure climatic variability due to topography, elevation, and storm patterns. This extensive network permits extrapolation of data over the entire project area with a fairly high degree of confidence.

Climatic data include precipitation, temperature, humidity, solar radiation, windspeed and direction, dew-point temperature, evaporation, and snowpack. Strip chart recorders are used to monitor all elements except snowpack, which is sampled manually. Storm duration, storm precipitation total, and yearly precipitation total are determined from precipitation charts. All climatic data are summarized and stored at the project office and are readily available to other disciplines.

Vegetation

(1) Quantify changes in vegetation due to grazing management and range improvement treatments
(2) Determine reasons for the vegetation response measured

A vegetation trend study will be undertaken before the grazing plan is implemented and continue through the life of the project. This study will be conducted on a site-specific basis that includes the most extensive and important upland and riparian plant communities.

A combination of measurements will be used to assess vegetation changes. A positive or negative response to grazing management can be interpreted from changes in foliar cover of trees and shrubs; density of trees, shrubs, grasses, and forbs; basal area of grasses and forbs; frequency of occurrence of all species; species production; living and nonliving ground cover; and soil-surface characteristics.

Knowledge of the reasons for a vegetative response permits an understanding of the effectiveness of a treatment to fulfill a management objective, may suggest ways to improve effectiveness of a treatment, and establishes a basis for extrapolation of results. Some factors responsible for vegetation changes and the researchable subjects to be studied are as follows:
(1) Site potential and range condition
(2) Quantity and quality of seed produced by desirable and undesirable species
(3) Plant development at the time of grazing
(4) Degree of utilization
(5) Establishment of plants of desirable and undesirable species

Wildlife - Sage Grouse

(1) Define the seasonal movement and population distribution patterns of sage grouse by age and sex groups
(2) Characterize the seasonal habitats used by sage grouse during the year in relation to habitats available for use
(3) Evaluate and correlate the response of sage grouse and sage grouse habitat to grazing management systems and vegetation manipulation, particularly sagebrush plowing and seeding
(4) Develop management procedures for sage grouse and their habitat

Seasonal movements and population distribution will be determined by equipping several grouse each year with radio transmitters and banding a sample of birds with colored legbands coded to specific locations. Birds will be monitored throughout the year to determine their movements and to locate habitats used. The telemetry technique will be used to identify nest sites and brood areas. In addition, information on interstrutting ground movements and timing of female attendance at strutting grounds will be collected.

By monitoring seasonal movements, seasonal habitats will be located. The vegetation of these habitats will be measured for density, cover, and height of shrub species and ground-cover composition. Habitats available, based on vegetation classification and mapping, and habitat use will be evaluated throughout the study to monitor changes in sage grouse use due to grazing management and range improvements.

From the knowledge obtained of the seasonal movement, habitat use, and response to the grazing management program, sage grouse management guidelines will be developed. The goal is to provide ranchers and land management agencies with information on the interactions among sage grouse, livestock grazing, and vegetation manipulation for use in resource management programs.

Wildlife - Mule Deer

(1) Determine seasonal habitat preference, vegetation use patterns, and movement and distribution of mule deer
(2) Characterize vegetation on these habitats
(3) Evaluate the nutritive quality of forage selected by mule deer
(4) Quantify any diet overlap between cattle and deer

Observations of wild mule deer will be used to define the preferred habitat in the spring, summer, and fall. Change in habitats used will be determined as cattle enter and leave various pastures.

Tame deer will be used to study food selection before, during, and after cattle graze deer habitats. The effects of floristic alterations of vegetation due to cattle grazing will be evaluated by forage selection of tame deer in response to change in species composition and to structural, phenological, and nutritive characteristics of forage plants. Habitat structure and forage availability are described by vegetation analysis on each site where tame deer graze.

Wildlife - Nongame

(1) Determine short-term effects of range improvement practices, such as brush control and mixed species rangeland seeding, on nongame wildlife
(2) Determine long-term population responses of nongame wildlife to vegetation changes brought about by grazing management treatments

Two approaches will be used: (1) Key ecological site-animal community sampling and (2) representative species sampling. The former provides a means of detecting the sometimes subtle wildlife community changes, such as species diversity and relative abundance, which often result from habitat change. This type of sampling will also serve to indicate whether the representative species chosen for more intensive study are as important as originally presumed or whether other species are more responsive to land management treatments. Sampling will be limited to riparian zones and other important ecological sites in various pastures.

This second approach primarily involves monitoring of rodent and bird populations. Rodents will be studied because they are abundant, include a diversity of species, are fairly easy to sample, and respond quickly to changes in range condition. Also, the abundance, variety, and esthetic value of nongame birds make them obvious candidates for study of species diversity and relative abundance in key ecological sites. Emphasis will be placed on sampling animal communities in important sites before the grazing system begins and again at the end of the project. Some sampling will be conducted during the grazing system to help discern and correct for population cycles or for annual fluctuations caused by the weather.

Fisheries

(1) Measure the effects of livestock grazing treatments, including rest, on streamside vegetation cover, streambank stability, water column, and channel hydraulic-geometry parameters of aquatic environments
(2) Relate these conditions to--
    (a) Riparian-stream response
    (b) Fish response
    (c) Stream rehabilitation potential based on past, present, and future grazing strategies
    (d) Compatibility of deferred-rotation grazing with riparian-stream system

Techniques used in this study are also used on 16 other study sites--11 in Idaho, 3 in Utah, and 2 in Nevada. These sites are generally in meadow environments on NF

land and in lower elevation meadows in the sagebrush type on BLM land. A major purpose of these studies is to refine techniques for monitoring and assessing the impacts of livestock on riparian and aquatic ecosystems.

Data on the stream-fisheries systems will be collected in four categories: (1) Geomorphic-aquatic, (2) riparian, (3) hydrologic, and (4) biological. Geomorphic-aquatic measurements describe the physical structure of the stream and include information on width and depth of water, pool and riffle characteristics, and physical properties of the streambank and stream channel. Riparian data describe the vegetative cover and its stability at the interface between the aquatic and the terrestrial ecosystems. Hydrologic analysis describes changes in stream cross section due to erosion and deposition of materials in the channel. Information on these characteristics of a stream is used to document livestock-induced effects on the stream over time. These changes can be related to changes in the quantity and quality of fish populations measured in the biological phase of this study.

Livestock

(1) Evaluate economically important cattle production factors that may be affected by grazing treatments
(2) Determine the amount, composition, and quality of forage consumed by range cattle under different grazing treatments
(3) Evaluate the quality of cattle diets on different kinds of range grazed at different seasons

Long-term cattle productivity will be monitored on a sample of the herd by the following measurements:
(1) Percent conception (mid-October)
(2) Calf birth dates and birth weights (March)
(3) Weight gain of calves and yearlings on each pasture
(4) Percent calf crop weaned (October)
(5) Weaned calf weights (October)
(6) Yearling weights (October)
(7) Length of calving season

The amount and quality of forage consumed by cattle on each grazing treatment will be determined with rumen-fistulated and intact animals. Sampling with these animals will be conducted before the main herd grazes a pasture and again after the main herd has moved to another pasture.

Forage evaluation studies will include--
(1) Intake
(2) Digestible organic matter and digestible protein
(3) Acid-detergent fiber and lignin content
(4) Botanical composition of rumen and fecal samples

The nutritive quality of the diet consumed will be evaluated by the concentration of nutrients in animal tissue. Blood samples from cows, yearling steers, and yearling heifers will be collected at the start of the grazing season, at each time animals are moved among pastures, and during the winter feeding period. These samples will be analyzed for hematocrit, phosphorus, copper, selenium, zinc, nonprotein nitrogen, calcium, magnesium, and potassium.

Hydrology

(1) Measure the effects of cattle management and range improvements on the hydrologic processes within selected plant communities
(2) Test and validate procedures for predicting hydrologic responses to cattle management and range improvements
(3) Evaluate the potential for implementing soil and water conservation practices to reduce siltation of meadows and irrigation ditches and to increase water-use efficiency of hay meadows

Hydrologic studies address the effects of cattle management by measuring responses at three different spatial scales. Sediment samples and discharge measurements are taken at the U.S. Geological Survey and other stream-gauging stations located on the project area. These measurements will be used to indicate the overall effectiveness of the proposed grazing systems to reduce stream sediments. Streamflow and suspended

sediment measurements made at various points within the main channel system will document background levels and variability of water quantity and quality.

Several small watersheds (30-120 acres) have been instrumented for continuous recording of runoff from snowmelt and rainfall events. Measurement of herbage production, cover and frequency of occurrence by species, and forage utilization on the basins will provide a means for relating hydrologic response to vegetation characteristics and cattle management. Soil moisture, climate, and vegetation production will allow testing and possible improvements of forage-prediction models.

Rainfall simulation work permits development and testing of equations relating vegetation cover to upland soil erosion. Removal of vegetative biomass, and thus cover, can then be related to relative changes in soil loss.

Data from these spatial scales will be used in hydrologic models to indicate watershed response to cattle management and to suggest alternative management strategies.

Economics

(1) Collect resource and economic data useful for economic analysis of the Saval Ranch

(2) Catalog and evaluate available computer programs and expedite use of existing computer programs appropriate for the Saval Ranch

(3) Provide analysis of--

- (a) Tradeoff relationships of range cattle use versus other multiple uses on public lands
- (b) Effects of Federal land-use decisions on private property values, rancher income, rancher capital, and land-use practices
- (c) Estimation of benefits and costs by user groups and agencies

The following studies are designed to achieve these objectives:

(1) Evaluate data collected by other groups with respect to their usefulness for economic analysis; suggest modifications and identify time frames for data products; develop records to be kept by agency, rancher, and others

- (a) Specify data needed from the range, livestock, and wildlife groups and the Saval Ranch
- (b) Use budget analysis to obtain cost of production for the Saval Ranch (all available production, income, marketing, etc.)
- (c) Survey ranchers in Elko County to develop ranch budgets for comparative analysis

(2) Assemble and evaluate linear programming and input-output models that can be used to evaluate the coordinated management plan developed for the Saval Ranch

(3) Prepare economic feasibility analysis of the management systems developed for the Saval Ranch, such as grazing system and range improvements

- (a) Costs of each alternative (rancher, agency, other)
- (b) Returns (rancher, agency, other), including estimation of economic value for non-market outputs, such as game and nongame wildlife, fish, and soil protection
- (c) Economic effects of proposed actions

(4) Estimate the impacts of implementing grazing systems on all ranches in Elko County on the local economy. Recommend mitigating measures for adverse impacts, if any. Use regional input-output models to determine economic and sociological significance of the range livestock industry

Research Design, Integration, and Synthesis

(1) Develop a systems model

(2) Integrate research disciplines

(3) Identify significant hypotheses that can be tested to evaluate the overall effects of the Saval Ranch management plan

(4) Provide a means of technology transfer

Development of the disciplinary and integrated research program for the Saval project has been guided by a simulation model of the physical, biological, and economic ranch system. The total system was divided into four subsystems: Climatology-hydrology, vegetation, wildlife, and livestock-economic. A submodel was built separately for each subsystem, then integrated into an overall model. The common link among disciplines is vegetation. Growth of vegetation is dependent on climatological and hydrological factors. Vegetation protects the soil and provides the habitat and food for wildlife. Cattle convert vegetation into animal protein, and beef is sold as the ranch product. Over the life of the study, the submodels and overall models will be used to guide the design of new research as it evolves in response to some questions being answered and others becoming obvious. Throughout this process, research will be conducted to validate the model. As new data are collected and as understanding of the function of the Saval Ranch system improves, the model can be refined and will become more realistic and useful as a predictive and extrapolative management tool.

DATA MANAGEMENT

A data management system has been developed to locate, store, access, and analyze the inventory, monitoring, and research data accumulated by the Saval project. The Universal Transverse Mercator system will be used to store, sort, and retrieve spatial data about various resources by 2.5-acre cells. All information will be entered into a REX 2 data base. Both storage and analyses will be done on a Honeywell DPS8 computer located at BLM's Denver Service Center. Entries into this system can be made from remote terminals in Nevada and Idaho where project scientists are located.

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APPENDIX

Common and Scientific Names of Organisms Mentioned in the Text[1]

Common name	Scientific name
Trees and shrubs	
Antelope bitterbrush	*Purshia tridentata*
Common chokecherry	*Prunus virginiana*
Mountain snowberry	*Symphoricarpos oreophilus*
Owyhee sagebrush	*Artemisia papposa*
Quaking aspen	*Populus tremuloides*
Rabbitbrush	*Chrysothamnus* spp.
Sagebrush	*Artemisia* spp.
Utah serviceberry	*Amelanchier utahensis*
Willow	*Salix* spp.
Grass and grasslike species	
Bluegrass	*Poa* spp.
Bromegrass	*Bromus* spp.
Crested wheatgrass	*Agropyron desertorum*
Fescue	*Festuca* spp.
Great Basin wildrye	*Elymus cinereus*
Needlegrass	*Stipa* spp.
Rush	*Juncus* spp.
Sedge	*Carex* spp.
Squirreltail	*Sitanion hystrix*
Wheatgrass	*Agropyron* spp.
Forbs	
Arching pussytoes	*Antennaria arcuata*
Aster	*Aster* spp.
Balsamroot	*Balsamorhiza* spp.
Groundsel	*Senecio* spp.
Hawksbeard	*Crepis* spp.
Milkvetch	*Astragalus* spp.
Phlox	*Phlox* spp.
Wild buckwheat	*Eriogonum* spp.
Wyethia	*Wyethia* spp.
Mammals	
Badger	*Taxidea taxus*
Beaver	*Castor canadensis*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
Bushy-tailed wood rat	*Neotoma cinerea*
Cottontail rabbit	*Sylvilagus nuttalli*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Great Basin pocket mouse	*Perognathus parvus*
Least chipmunk	*Eutamias minimus*
Long-tailed weasel	*Mustela erminea*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*
Pronghorn antelope	*Antilocapra americana*

[1]For an annotated list of most plants and animals for a similar ecosytem, see Roundy (1980) and McAdoo (1980), respectively.

Common name	Scientific name
Mammals (con.)	
Pygmy rabbit	Sylvilagus idahoensis
Richardson's ground squirrel	Spermophilus richardsoni
Sagebrush vole	Lagurus curtatus
Townsend's ground squirrel	Spermophilus townsendi
White-tailed jackrabbit	Lepus townsendii
Birds	
American kestrel	Falco sparverius
Blue grouse	Dendragapus obscurus
Brewer's blackbird	Euphagus cyanocephalus
Brewer's sparrow	Spizella breweri
Canada goose	Branta canadensis
Chukar	Alectoris chukar
Cinnamon teal	Anas cyanoptera
Cooper's hawk	Accipiter cooperii
Golden eagle	Aquila chrysaetos
Goshawk	Accipiter gentilis
Great horned owl	Bubo virginianus
Green-tailed towhee	Pipilo chlorurua
Hungarian partridge	Perdix perdix
Long-eared owl	Asio otus

Common name	Scientific name
Birds (con.)	
Mallard	Anas platyrhynchos
Marsh hawk	Circus cyaneus
Mourning dove	Zenaidura macroura
Pintail	Anas acuta
Red-tailed hawk	Buteo jamaicencis
Red-winged blackbird	Agelaius phoeniceus
Robin	Turdus migratorius
Sage grouse	Centrocercus urophasianus
Sage thrasher	Oreoscoptes montanus
Savannah sparrow	Passerculus sandwichensis
Swainson's hawk	Buteo swainsoni
Vesper sparrow	Pooecetes gramineus
Warbling vireo	Vireo gilvus
Western meadowlark	Sturnella neglecta
Yellow warbler	Dendroica petechia
Fish	
Lahontan cutthroat trout	Salmo clarki ssp. henshawi